Aerosol retrievals from proposed satellite bistatic lidar observations: accuracy and information content

Mikhail D. Alexandrov[a,b,*] and Michael I. Mishchenko[b]

[a]*Columbia University, 2880 Broadway, New York, NY 10025, USA*
[b]*NASA Goddard Institute for Space Studies, 2880 Broadway, New York, NY 10025, USA*

[*]*Presenting author (mda14@columbia.edu)*

Accurate aerosol retrievals from space remain quite challenging and typically involve solving a severely ill-posed inverse scattering problem. We suggested to address this ill-posedness by flying a bistatic lidar system. Such a system would consist of formation flying constellation of a primary satellite equipped with a conventional monostatic (backscattering) lidar and an additional platform hosting a receiver of the scattered laser light [1,2]. If successfully implemented, this concept would combine the measurement capabilities of a passive multi-angle multi-spectral polarimeter with the vertical profiling capability of a lidar. Thus, bistatic lidar observations will be free of deficiencies affecting both monostatic lidar measurements (caused by the highly limited information content) and passive photopolarimetric measurements (caused by vertical integration and surface reflection).

We present an accuracy assessment study for a bistatic lidar system consisting of a high spectral resolution lidar (HSRL) and an additional receiver flown in formation with it at a scattering angle of 165°. This study uses synthetic data generated using Mie-theory computations. The model/retrieval parameters in our tests were the effective radius and variance of the aerosol size distribution, complex refractive index of the particles, and their number concentration. Both mono- and bimodal aerosol mixtures were considered. Definitive evaluation of error propagation from measurements to retrievals was performed using a Monte Carlo technique, which involves random distortion of the observations and statistical characterization of the resulting retrieval errors. Our tests demonstrated that supplementing a conventional monostatic HSRL with an additional receiver dramatically increases the information content of the measurements and allows for a sufficiently accurate characterization of tropospheric aerosols.

References

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Preferred mode of presentation: Oral